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$\therefore h=37^\circ\ 37'$ or $137^\circ\ 18'\ 12''$. $h=2$ hours, 30 minutes, 28 seconds, or 9 hours, 9 minutes, 12.8 seconds.

$\therefore$ sidereal time $=1$ hour, 22 minutes, 28 seconds, or 8 hours, 1 minute, 12.8 seconds.

36. Proposed by J. K. ELLWOOD, A. M., Principal of the Colfax School, Pittsburg, Pennsylvania.

"What is the length of a chord cutting off one-fifth of the area of a circle whose diameter is 10 feet?"

I. Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Applied Science, Texarkana College, Texarkana, Arkansas-Texas.

Let the chord subtend an angle $=2\theta$, $a=$radius of circle. Then the length of the chord $=2a\sin\theta$.

$\therefore a^2(\theta-\sin\theta\cos\theta)=\frac{1}{5}\pi a^2$.

$\therefore \theta-\sin\theta\cos\theta=\frac{1}{5}\pi$, $\therefore \theta=60^\circ 32'$ nearly.

$\therefore$ chord $=2a\sin\theta=10\sin\theta=8.7064$ feet.

II. Solution by BENJ. F. YANNEY, A. M., Professor of Mathematics, Mount Union College, Alliance, Ohio, and Prof. P. S. BERG, Larimore, North Dakota.

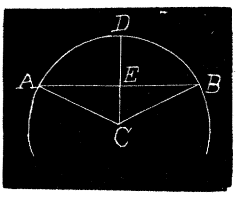
Let $\theta=$the angle at the center, subtended by the required chord. Then $10\sin\theta=$the length of the required chord. Now $\frac{2\theta}{360}\pi 25$, the area of the sector, $-5\sin\theta\sqrt{(25-25\sin^2\theta)}$, the area of the triangle, $=5\pi$, the given area of the segment. Whence, by reduction, $\frac{\theta}{180}\pi-\sin\theta\cos\theta=\frac{\pi}{5}$.

$\therefore \frac{\theta}{90}\pi-2\sin\theta\cos\theta=\frac{2}{5}\pi$. $\therefore .0349065\theta-\sin 2\theta=1.256637$.

From which we readily find, by supposition, the value of θ; and from this, the value of $10\sin\theta$ to be 8.706, the length of the chord required.

III. Solution by A. H. BELL, Hillsboro, Illinois.

By Reversion of Series. Let the given diameter $=10=D$ and $1/5$ of circle $=a\pi r^2/d$, radius $=r$. To obtain the greatest convergency in the series, let ACB, the angle at the center $=2\theta$ and take the sector $ACD=r^2\theta/2$ and $r^2\sin\theta\cos\theta/2=ACE$.



Then $r^2(\theta-\sin\theta\cos\theta)/2=a\pi r^2/2d$ or $\text{arc}\theta=a\pi/d+\cos\theta\sqrt{(1-\cos^2\theta)}$ .....(1).

Make $\cos\theta=x$, and when expanded,

$$\theta=\frac{a\pi}{d}+x-\frac{x^3}{2}-\frac{x^5}{2.4}-\frac{3x^7}{2.4.6}-\frac{3.5x^9}{2.4.6.8}, \text{ etc.,}.....(2).$$

By trigonometry or calculus, we have,

$$\text{arc}\theta=\frac{\pi}{2}-x-\frac{x^3}{2.3}-\frac{3x^5}{2.4.5}-\frac{3.5x^7}{2.4.6.7}-\frac{3.5.7x^9}{2.4.6.8.9}, \text{ etc.,}.....(3).$$

(2)−(3) and ÷ by 2, etc.,

$$y=\frac{(d-2a)\pi}{4d}=x-\frac{x^3}{6}-\frac{x^5}{40}-\frac{x^7}{112}-\frac{5x^9}{1152}-\text{ etc.,}\ldots\ldots\ldots(4).$$

Assume $x=Ay+By^3+Cy^5+Dy^7+Ey^9+$ etc.,.....(5).

The powers of x substituted in (4), $y=Ay+$

$$\left(B-\frac{A^5}{6}\right)y^3+\left(C-\frac{A^2B}{2}-\frac{A^5}{40}\right)y^5+\left(D-\frac{A^2C}{2}-\frac{AB^2}{2}-\frac{A^4B}{8}-\frac{A^7}{112}\right)y^7+\text{etc.}$$

$\therefore A=1$, $B=1/6$, $C=13/120$, $D=493/5040$, $E=37369/362880$, etc., in (5).

$x=\cos\theta=y+y^3/6+13y^5/120+493y^7/5040+37369y^9/362880+$ etc,,....(A).

Substituting values, $y=3\pi/20=0.471239=$logarithm $\bar{1}.673241+$.

2nd = 0.017441
3rd = 0.002517
4th = 0.000505
5th = 0.000118
Estimated = 0.000025

$\cos\theta=0.491845$

2nd term $y^3=\bar{1}.019724-$ 6 0.778151.

$0.017441=\bar{2}.241573$

3rd term $y^5=\bar{2}.366206$

$13/120=\bar{1}.034762$

$0.002517+=\bar{3}.400968$

4th term $y^7=\bar{3}.712688$

$493/5040....\bar{2}.990416$

$0.000505--=\bar{4}.703104$

5th term $y^9=\bar{3}.059171$

$37369/362880....\bar{1}.012737$

$0.00018=\bar{4}.071908$

Chord $AB=10\sqrt{(1-\cos^2\theta)}=8.7068+$. $ACD=60°32'17''$ nearly.

NOTE.—Formula (A) is also a general solution for the height of the circular segment (see problem 37, page 75, Vol. II). When the angle ACD is less than 50°, solve (1) for $\sin\theta$, and we have,

$$\theta<50°=\sin\theta=\left(\frac{3a\pi}{2d}\right)^{\frac{1}{3}}-\frac{1}{10}\left(\frac{3a\pi}{2d}\right)^{\frac{3}{3}}-\frac{1}{1400}\left(\frac{3a\pi}{2d}\right)^{\frac{5}{3}}-\frac{71}{252000}\left(\frac{3a\pi}{2d}\right)^{\frac{7}{3}}-\text{, etc.,..}(B).$$

Chord$=D.\sin\theta$. It will be noticed that the convergency, in part, depends on the smallness of the value of y.

PROBLEMS.

42. Proposed by E. B. ESCOTT, 6123 Ellis Avenue, Chicago, Illinois.

To find a triangle whose sides and median lines are commensurable.

43. Proposed by H. C. WILKES, Skull Run, West Virginia.

To find, if possible, a right angled triangle, the bisectors of the acute angles of which, can be expressed by integral whole numbers.